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NAVY EXPERIMENTAL DIVING UNIT PANAMA CITY FLA
FIRST-ARTICLE TEST OF THE MK 1 MOD 0 MASK (MORSE MODEL), (U)
APR 77 D J SCHMITT

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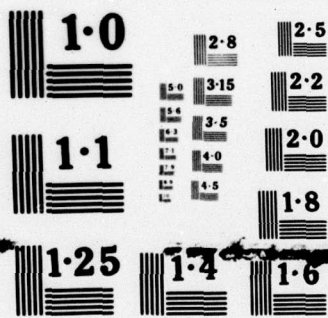
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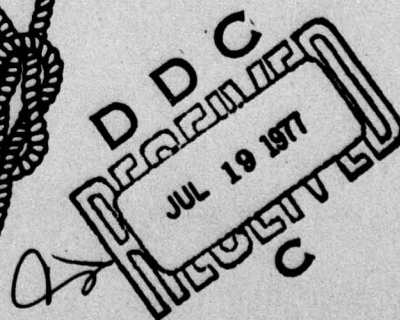
NAVY EXPERIMENTAL DIVING UNIT

REPORT 3-77

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FIRST-ARTICLE TEST OF THE
MK 1 MOD 0 MASK (MORSE MODEL)

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Panama City, Florida 32407

NAVY EXPERIMENTAL DIVING UNIT
REPORT NO. 3 -77

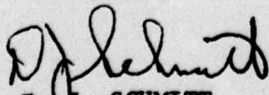
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D.J. SCHMITT

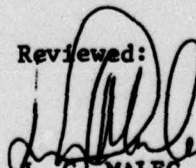
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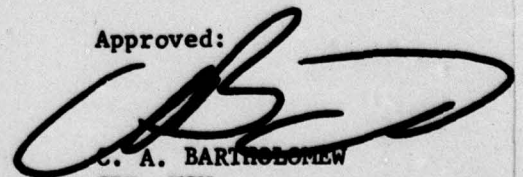
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The MK 1 Mod 0 mask, manufactured by Morse Diving Equipment Co. under Contract N00024-76-C-4184, was submitted to the Navy Experimental Diving Unit for first-article test in December 1976. The test plan was based on the specification given the Contractor, primarily the drawing package. The MK 1 Mod 0 mask passed all tests successfully. NEDU, however, recommends some further changes and review of number of spares provided.		

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ABSTRACT

The first USN MK 1 Mod 0 mask built by Morse Diving Equipment Company, Inc., of Boston, Massachusetts under Contract No. N00024-76-C-4184 was delivered to the Navy Experimental Diving Unit in Panama City, Florida in December 1976.

First-article test was conducted during the week of 5 December 1976. The first-article test plan was developed from the specification, primarily the Contractor's drawing package.

The mask passed all tests successfully. However, testing revealed some deficiencies and led to recommendations for minor change and review of some MK 1 Mod 0 mask requirements.

INTRODUCTION

The USN MK 1 Mod 0 Band Mask built by U.S. Divers under Contract N00024-76-C-5477 has been in Fleet service for approximately 4 years. The USN MK 1 Mod 0 is a development especially for the U.S. Navy and is an adaptation of the U.S. Divers Kirby-Morgan KMB-9. At the end of that contract, bids were solicited for 38 sets plus 1 for first-article testing. The subsequent contract was awarded to the Morse Diving Equipment Company, Inc., of Boston, Massachusetts in March 1976 under Contract No. N00024-76-C-4184.

The first MK 1 Mod 0 mask under Contract N00024-76-C-4184 was delivered to the Navy Experimental Diving Unit (NEDU) in Panama City, Florida in December 1976. NEDU performed first-article testing during the week of 5 December 1976 in accordance with a test plan developed by NEDU covering the specifications (primarily the Drawing Package) given to the Contractor.

TEST EQUIPMENT REQUIRED

The following test equipment was required to test the MK 1 Mod 0 mask. Test equipment was set up as shown in figures 1 through 5. The numbers in parentheses refer to these figures.

- a. MK 1 Mod 0 mask (1)
- b. Validyne pressure transducer with 0.50 psid diaphragm (2)
- c. Validyne pressure transducer with 1.00 psid diaphragm (3)
- d. Two Validyne CD-12 transducer-indicators (4)
- e. X-Y plotter (5)
- f. Scuba tank, 71.5 cubic foot (6)
- g. NEDU chamber complex D (7)
- h. Air pressure gauge, 0 to 3000 psig (8)
- i. Air pressure gauge, 0 to 300 psig (9)
- j. Dome loader (10)
- k. Breathing machine with piston position transducer (11)
- l. Laminar flow element (LFE), 100 scfm (12)
- m. Wet test box (13)

- n. Mannikin (14)
- o. First stage regulator with relief valve (15)
- p. Flow orifice, 0.03 ± 0.001 dia. x 1.700 long (16)

TEST PROCEDURES AND RESULTS

a. Controlled Parameters. During this test, the following parameters were controlled.

- 1. Supply pressure to side block
- 2. Supply pressure to first stage regulator
- 3. Position of "dial-a-breath" knob on the second stage regulator
- 4. Position of defogger and emergency valves on side block
- 5. Static outlet pressure from first stage regulator

b. Measured Parameters. The following parameters were measured.

- 1. Flow into oral-nasal cup from second stage regulator
- 2. Flow out of side valve defogger
- 3. Flow out of tubing between side valve and second stage regulator
- 4. ΔP (pressure differential) in oral-nasal cup
- 5. Relief valve setting on first stage regulator
- 6. Dynamic pressure at first stage outlet under various conditions
- 7. Leak integrity under all test conditions.

c. Inspection. A complete inspection of the mask was made in accordance with the receiving checklist. The mask was checked for damaged or missing parts. The lens was checked for cracks, scratches, and distortion, and the lens-retaining screws were checked for tightness. The function of the nose clearing device was checked. The hood, spider, and oral-nasal mask were inspected for tears, cracks, and deterioration. Finally, all metal parts were checked for corrosion, peeling, chipping, galling between mating parts, and nicks and burs. No defects were observed.

d. Second-Stage Regulator Test. The test equipment was set up for this test as shown in figure 1. With the defogger and emergency valves closed, the second stage regulator was supplied air pressure at 60 psig. The dial-a-breath knob was turned fully out, and the LFE indicated a free flow condition in the

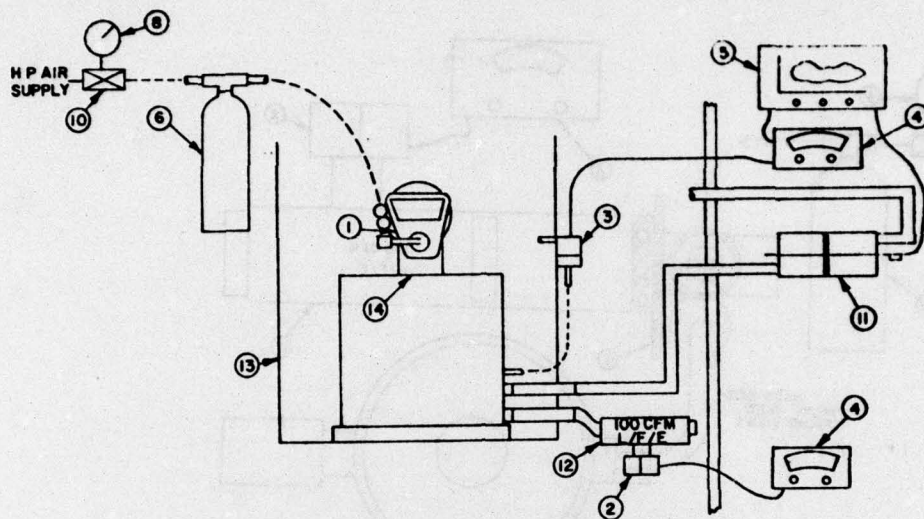


FIGURE 1. SETUP FOR TEST

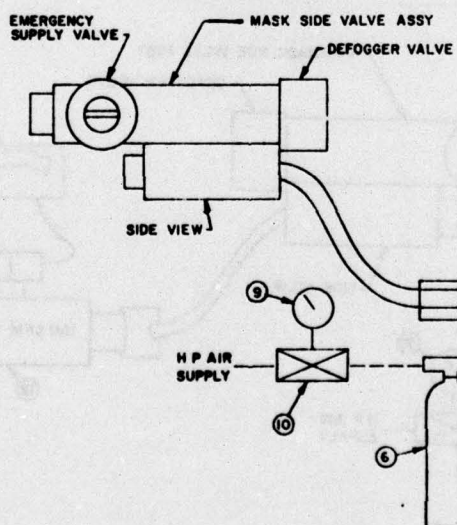


FIGURE 2. SETUP FOR TEST - Continued

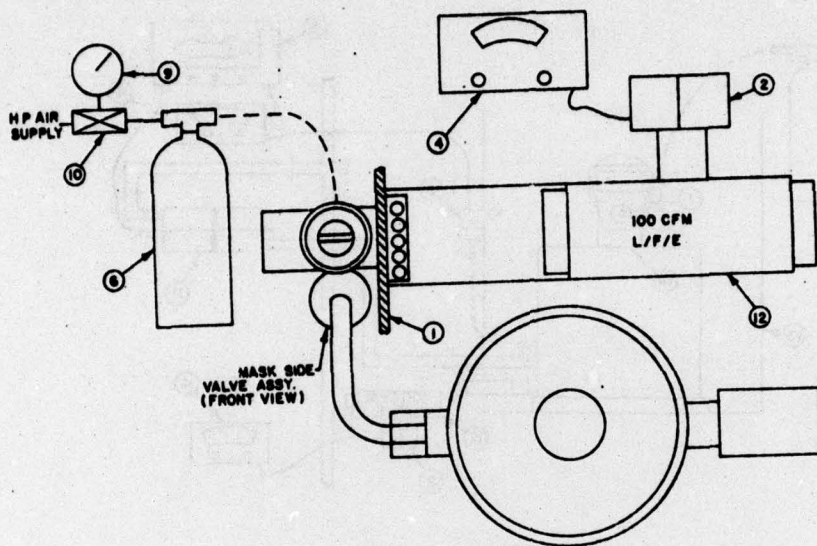


FIGURE 3. SETUP FOR TEST - Continued

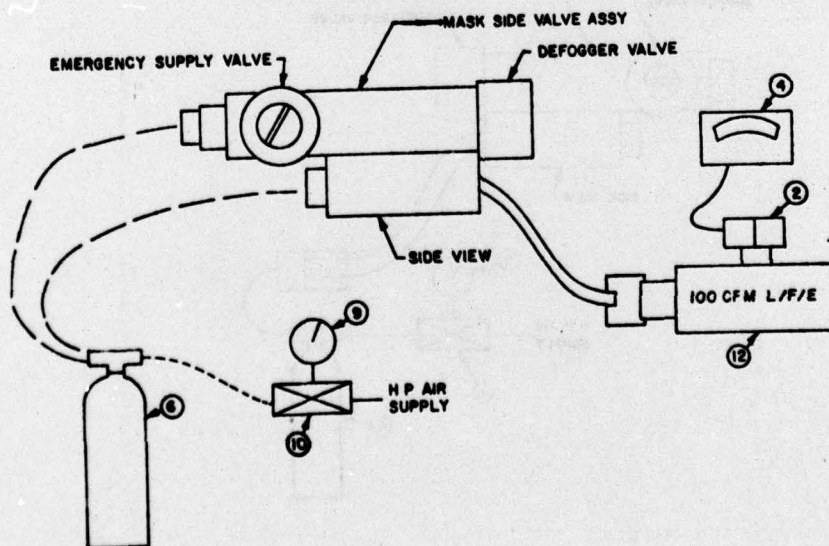


FIGURE 4. SETUP FOR TEST - Continued

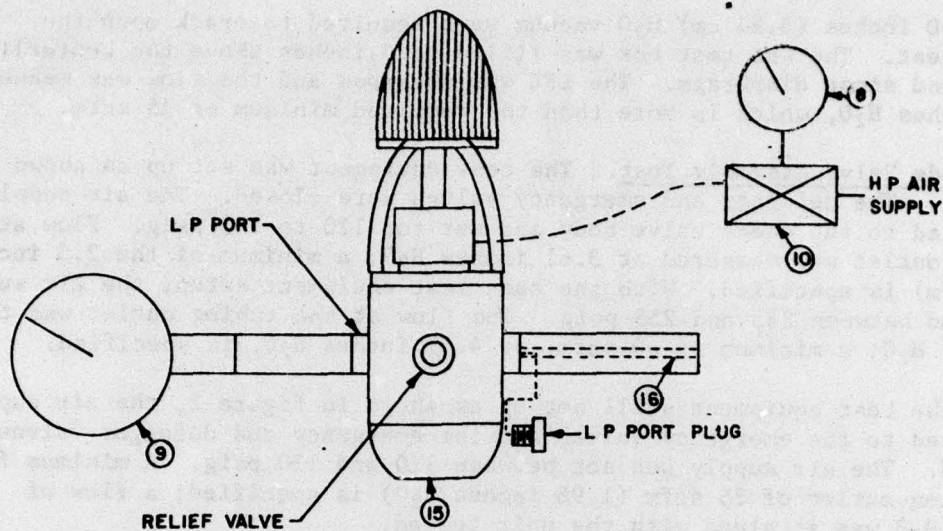


FIGURE 5. SETUP FOR TEST - Continued

mask. Free flow was achieved and then the dial-a-breath knob was turned in until free flow stopped. Six turns of the knob were required to stop free flow.

The supply pressure was then increased to 80 psig (static). The dial-a-breath knob was turned out until free flow was achieved. As the line was fully opened, the knob was turned back in until flow completely stopped. Free flow was stopped by eight and one-fourth turns of the dial-a-breath knob. This test was then performed with each of the following supply pressures.

<u>Supply Pressure (psig)</u>	<u>Turns Req'd To Stop Free Flow</u>
100	8
120	10
140	12-1/4
160	9-1/2
180	7-1/2

Full travel of the dial-a-breath knob from fully open to fully closed is 16-1/4 turns.

The wet test box was filled with water until the primary and secondary exhaust ports were barely submerged. No leaks were detected. The supply pressure was adjusted to 130 psig. With the defogger and emergency valves closed, the breathing machine was started (the outlet to the LFE was capped). The dial-a-breath knob was adjusted until between 0.60 inch (1.52 cm)

H₂O and 1.50 inches (3.81 cm) H₂O vacuum were required to crack open the regulator seat. The wet test box was filled to 3 inches above the centerline of the second stage diaphragm. The LFE was uncapped and the flow was measured at 1.18 inches H₂O, which is more than the required minimum of 15 scfm.

e. Side Valve Assembly Test. The test equipment was set up as shown in figure 2. The defogger and emergency valves were closed. The air supply was connected to the check valve body and set for 120 to 130 psig. Flow at the tubing outlet was measured at 3.61 inches H₂O; a minimum of the 2.3 inches H₂O (15 scfm) is specified. With the same test equipment setup, the air supply was adjusted between 245 and 255 psig. The flow at the tubing outlet was then 6.35 inches H₂O; a minimum of 60 scfm, or 4.87 inches H₂O, is specified.

With the test equipment still set up as shown in figure 2, the air supply was connected to the emergency valve, and the emergency and defogger valves were opened. The air supply was set between 120 and 130 psig. A minimum flow at the tubing outlet of 25 scfm (1.98 inches H₂O) is specified; a flow of 2.4 inches H₂O was attained with the unit tested.

The test equipment setup shown in figure 3 was then used. The air supply was connected to the emergency valve, and the emergency valve and defogger valves were left open. The air supply was set between 120 and 130 psig. Flow was measured at the side block outlet. A minimum flow of 35 scfm (2.79 inches H₂O) is specified; 2.85 inches H₂O was attained with the unit tested.

The test equipment was then set up as shown in figure 4. The air supply was connected to the air tubing outlet and the emergency and defogger valves were closed. The air supply was set for 250 psig. The unit was then dip tested for leaks. No leaks were detected.

f. First Stage (Emergency) Regulator Test. The test equipment was set up as shown in figure 5. A port plug was installed in place of the orifice and the air supply was adjusted to 250 ± 50 psig (static). The first stage outlet pressure was adjusted to 175 ± 25 psig to check that the relief valve lifted within this range. The relief valve lifted at 190 psig.

The burst strength of the hose between the first stage regulator and the side valve was verified to be 1600 psig, as specified.

g. Emergency Tank. The hydrostatic test date on the emergency tank was 1-76+, the + denoting that the tank can receive 10 percent overfill. The bottle was charged to 2500 psig and the K valve was checked for leaks at 50 psig and 2500 psig. No leaks were detected.

h. Umbilical Test. The lifeline was verified to be 1/2-inch, 5-strand line with a breaking strength of 7260 pounds. The snap hook tensile strength was successfully tested at 1400 pounds. The pneumofathometer hose and gas supply hose, both Swan hoses, are in accordance with Military Specification H-2815-E. The umbilical was pressurized to 300 psig and dip tested. No leaks were detected.

i. Spare Parts Kit. The spare parts kit contained enough spares (cylinder valves, demand valves, and first stage regulators) to repair four masks.

CONCLUSIONS AND RECOMMENDATIONS

Although the MK 1 Mod 0 mask successfully passed first-article testing, some deficiencies were noted. NEDU, therefore, recommends that the following changes be made on this and future MK 1 Mod 0 procurements.

a. Mask Assembly.

1. The band top and band bottom should have the spider-securing "dumbbells" angled forward at 15 degrees to help secure the spider.
2. The screw holes that secure the band top to the band bottom should be arranged so that the securing screws can be installed from the top. These screws should be chromed.
3. The head and face seal should be recut so that the center seam at the chin is offset to the side into a V-shape.
4. All masks should be marked on the side block (e.g., M0001; M = Morse) to ensure future identification.
5. The design of the cover main exhaust should be reviewed and the use of Morgan Systems part No. 17-096 should be investigated.

b. Umbilical.

1. Stainless-steel hose clamps should replace the present silicone bronze clamps.
2. The Swan hose should be marked with the dates of manufacture and test in accordance with the U.S. Diving Manual.
3. The pneumofathometer hose should be changed to 5/16-inch oxygen hose.
4. The size of the diver's gas hose should be reviewed. Although standardization requirements indicate the hose size should be 1/2-inch ID, it is heavier than the 3/8-inch hose now used, and is less suitable for lightweight diving.
5. The composition of the lifeline should be investigated. Although the size of the treated Dacron line is satisfactory, the braided composition makes it extremely susceptible to cutting and snagging. The requirement for 7000-pound breaking strain may be excessive; therefore, that requirement should also be reviewed.
6. The umbilical should be made up as specified in the U.S. Diving Manual.

c. Spares.

1. All spares should be individually packaged instead of batch-packed to keep items in good condition until they are required for use.
2. The parts list should be reviewed relative to the number of spares.

d. Miscellaneous.

1. All drawings should be updated.
2. NEDU should be custodian of master vellums. Other sets could be at OOC (Department of Ocean Engineering) and with the manufacturer.
3. For shipping, the emergency bottle should be filled with 200-psig air instead of nitrogen.
4. A. U.S. Divers "Mariner Pac" backpack, or one of similar design, is recommended to replace the presently furnished "Clamshell" backpack.

APPENDIX A

MAN-HOURS REQUIRED FOR TEST

The following man-hours were required for first-article test of the MK 1 Mod 0 mask.

	<u>Man-Hours</u>
Complex setup/cleanup: 5 men, 8 hours	40
Complex operation: 5 men, 50 hours	250
Reporting: 3 men, 8 hours	24
Duplicating: 1 man, 4 hours	<u>4</u>
Total man-hours required	318